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Original research article

Severe coronary artery disease as predicted by carotid intima media thickness

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ABSTRACT

INTRODUCTION: Carotid artery intima-media thickness (CIMT) measurement is a non-invasive method to diagnose early atherosclerosis or predict the risk of myocardial infarction and stroke. Increased CIMT in the common carotid segment is accompanied by yearly risk of 0.7%– 2.2% in coronary heart disease, 0.4%–1.8% for stroke and from 1.8% to 3.2% for total cardiovascular disease. The aim of the study is to find the predictor role of CIMT in detection of severe form of Coronary artery disease (CAD).

METHODS: 100 Cases selected from CAD patients who underwent PTCA. CIMT measurements done in all at common carotid artery level. CIMT measurements compared with number of coronary arteries involved using appropriate statistical tests.

RESULTS: Baseline characteristics like mean age, male sex, obesity, dyslipidemia, diabetes, hypertension, smoking and family history were comparable to regional prevalence. The mean CIMT was 1.11 mm. the mean CIMT in single vessel disease, double vessel disease, and triple vessel disease & Left main coronary artery (LMCA) groups was 0.96, 1.15, 1.34 and 1.25 mm respectively which was significant P <0.001. Univariate and multivariate linear regression analysis showed a significant correlation between CIMT and severity of CAD with the $R = 0.3$ & $P \leq 0.001$.

CONCLUSION: CIMT independently predicts presence of severe CAD in form of multivessel and LMCA involvement. Deploying CIMT evaluation in low and intermediate risk individual(s) to detect severe form of CAD will be a good strategy in resource limited setting specially where invasive modalities are not easily available.

Keywords: CIMT, CAD, LMCA, Multivessel

INTRODUCTION:

Carotid artery disease is a manifestation of atherosclerosis and is very often present concurrently with coronary artery disease (CAD) and peripheral artery disease.[1] Carotid artery intima-media thickness (CIMT) measurement is a non-invasive method to diagnose early atherosclerosis or predict the risk of myocardial infarction and stroke. Increased CIMT in the common carotid segment is accompanied by yearly risk of 0.7%–2.2% in coronary heart disease, 0.4%–1.8% for stroke and from 1.8% to 3.2% for total cardiovascular disease.[2] The aim of the study is to find the predictor role of CIMT in detection of severe form of CAD in patients.

AIMS AND OBJECTIVE:

1. To study the association between CIMT and severity of CAD.
2. To study the value of CIMT in prediction of severe form of CAD.

MATERIAL AND METHODS:

All participants written consent was obtained before including them in study. The design of the work has been approved by Haryana state ethical committee.

Study participants:

100 cases were selected based upon the crtieria given below.

Inclusion criteria:

Case:

1. Confirmed CAD based upon coronary angiography who underwent percutaneous transluminal coronary angioplasty (PTCA)

Exclusion criteria:

1. Hemodynamically unstable patient.
2. Any history of congenital pro-atherosclerotic condition like: familial hypertriglyceridemia etc.
3. Drugs increasing atherosclerotic risk: anti-retrovirals, chemotherapy for cancers, systemic steroids etc.
4. Patient who did not give consent for the study

Study Methodology:

The study was conducted over a period of one year. After proper written informed consent detailed history and baseline characteristics were obtained including age, gender, hypertension (blood pressure >140/90 mm hg And/or those already taking treatment for hypertension), Diabetes mellitus (fasting blood glucose >126 mg/dl and/or Postprandial blood glucose >200 mg/dl and those who were On treatment for diabetes mellitus), smoking status, and dyslipidemia; Total cholesterol ≥200 mg/dl (5.16 mmol/l) or low-density Lipoprotein >130 mg/dl (3.38 mmol/l) or High density Lipoprotein cholesterol <40 mg/dl 1.03 mmol/l) or Triglycerides ≥150 mg/dl (3.87 mmol/l) and Obesity (Body mass index>25.0 kg/m^2).

CIMT measurements were obtained in all participants of case and control group. CIMT measurement was obtained with the patient lying in the supine position and the neck rotated to opposite side. After transversely scanning the common carotid artery from the base of the neck to the carotid bulb, longitudinal images were taken to obtain the best lumen-intima interface. CIMT was the distance between the leading edges of lumen-intima interface and media-adventitia Interface measured in the far wall of the common carotid artery around 1 cm below the carotid bulb using electronic calipers manually. It was done in plaque-free region according to the guidelines recommendations at end diastole corresponding to the peak of *r* wave in Electrocardiogram. Carotid plaque is defined as a localized thickening of more than 1.5 mm in the intima of the artery. The measurements were done Using b-mode GE Voluson ultrasound machine with a 5–10 Mhz Linear phase array transducer. CIMT was assessed on both Sides of the neck and six values of CIMT (three on each side) are obtained and averaged to get mean CIMT.

Statistical analysis

The groups were compared regarding risk factors and CIMT. Values were expressed as means and standard deviation. Data obtained then analysed using SPSS 20.0 software. Proper statistical tests were done including

chi-square, Mann-whitney U test, one way and multifactorial Analysis of variance, and multifactorial logistic regression analysis. P value <0.05 was taken as significant.

RESULTS:

The baseline characteristics and demographic data obtained from the study population is shown in Table 1.

Table 2 shows the coronary arteries involved among the study participants along with their mean CIMT values and P-values as per ANOVA test.

Multivariate-linear regression analysis for all risk factors along with CIMT in prediction of severity of CAD is shown in Table 3.

DISCUSSION:

Limited studies are available where predictor strength of CIMT values has been tested for detection of severity of CAD. This study is a modest attempt in doing the same.

In our study the distribution of the various atherosclerotic risk factors corroborates very well with the previous literature which reiterates the relative frequency of these risk factors in the CAD patients in our country. [3,4]

In a study by Kasliwal *et al*.,[5] mean CIMT in the Indian population was found to be 0.608 ± 0.12 mm in men versus 0.579 ± 0.11 mm in women, which is lower than our study population. This is expected as our study population included 100 patients with significant CAD whereas Kasliwal *et al*.[5] have calculated mean CIMT in the general Indian population without significant CAD.

In our study, the mean CIMT in single vessel disease, double vessel disease, and triple vessel disease & Left main coronary artery (LMCA) groups was 0.96, 1.15, 1.34 and 1.25 mm respectively. Hence, the patients with high CIMT values had severe form of CAD. They had more frequent LMCA involvement and also multiple coronary arteries were having obstructive lesions, both of these findings were significant (Table 2). Similar finding of increasing CIMT with increasing coronary involvement was found by Kablak-Ziembicka *et al*.[6] and Tarzamni *et al*.[7] from Iran. They showed that patients with double and triple vessel disease had significantly higher CIMT than patients without CAD.

Linear regression analysis showed a significant correlation between CIMT and presence of CAD with the R = 0.3 ($P \leq 0.018$) in our study. By linear regression analysis, Hansa *et al*.[8] and Matsushima *et al*.[9] also found similar correlation of mean maximum CIMT with CAD (R = 0.28 and R = 0.411, respectively). Even Kablak-Ziembicka *et al*.[6] and Granér *et al*.[10] also found a significant linear correlation between CIMT and advancing CAD, while Adams *et al*.[11] showed a weak correlation.

In our study, multivariate linear regression analysis (Table 3) showed CIMT as the only significant variable which independently predicted severity of CAD i.e. number of vessels involved ($P \leq 0.001$). Other factors such as age, gender, family history, diabetes mellitus, hypertension, dyslipidemia, or smoking did not independently predicted severity of CAD. Among studies done on CIMT to predict CAD, the study by Hansa *et al*.,[8] only maximum CIMT was found to be the independent predictor of CAD, while no other risk factor had independent predictive value. The study by Djaberi *et al*.[12] and Coskun *et al*.[13] also showed CIMT to be an independent predictor of CAD by multivariate analysis.

We established the association of CIMT with severity of CAD both in univariate and multivariate linear regression analysis. The scatter plot (Fig. 1) clearly suggests that there is proportionate increase in severity of CAD with CIMT. This is in correlation with various studies done in the past. [6,14,15,16]

CONCLUSION:

It is known that in patients with suspected CAD; CIMT is simple and non-invasive tool to predict the presence of CAD but our study shows that high CIMT value fairly predicts severe form of obstructive CAD like multivessel and LMCA involvement irrespective of traditional atherosclerotic risk factors. Hence, deploying CIMT evaluation is beneficial in all cardiovascular risk categories individual(s) to predict severity of CAD specially in resource limited setting where invasive and higher modalities like CT or invasive coronary angiography are not easily available.

LIMITATIONS:

1. Small sample size
2. Non correlation with cardiac risk scores in the study population

FIGURES AND TABLES:

TABLE 1. BASELINE CHARACTERISTICS OF STUDY POPULATION

CHARACTERISTIC	CASES (N=100)
MEAN AGE (in years)	60.35
MALE (N or %)	66
OBESITY (N or %)	36
SMOKING (N or %)	54
FAMILY HISTORY (N or %)	46
DYSLIPIDEMIA (N or %)	47
HYPERTENSION (N or %)	42

***N=NUMBER**

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TABLE 2: MEAN CIMT IN STUDY POPULATION AS PER CORONARY ARTERIES INVOLVED

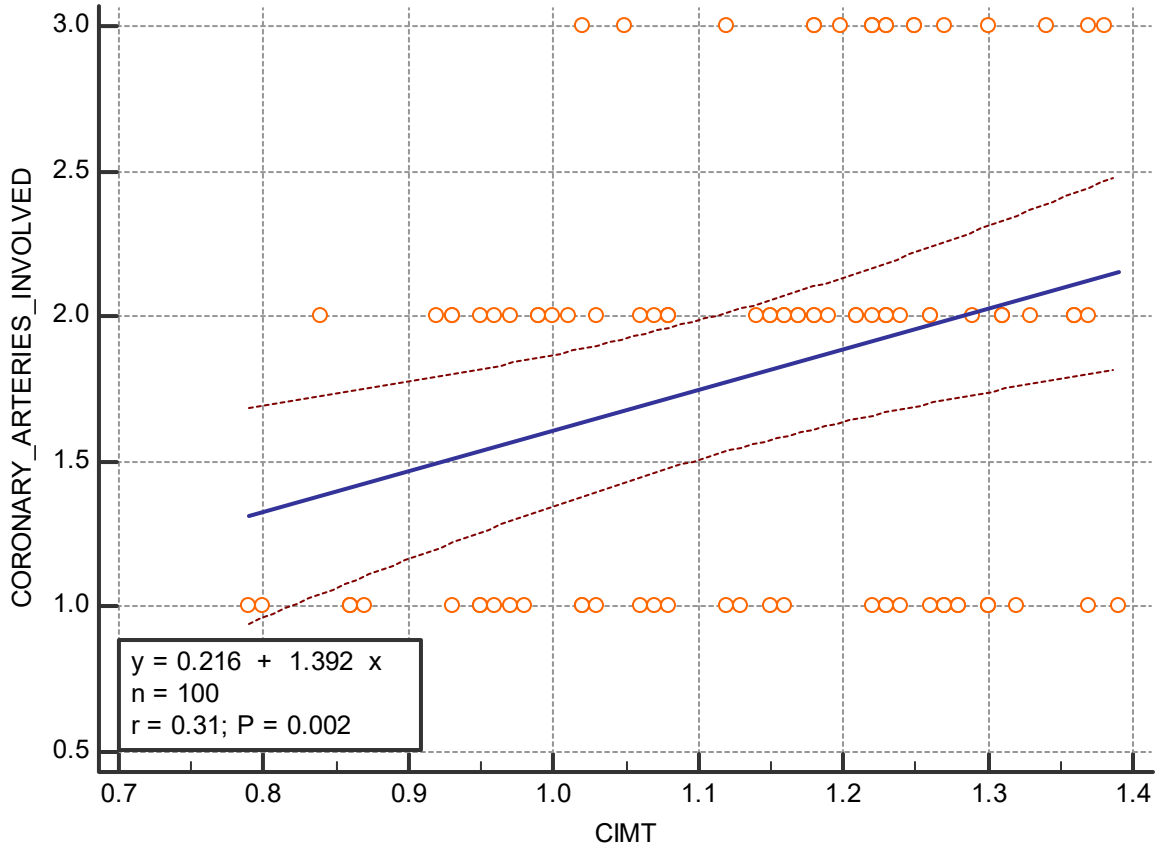
CHARACTERISTIC	CASES **(N or %)**	MEAN CIMT (in mm)	S.D.	S.E.	P-value (As per ANOVA)
CORONARY ARTERIES INVOLVED	100	1.11	0.164	0.0164	
SINGLE	37	0.96	0.1117	0.0184	P<0.001
DOUBLE	45	1.15	0.0841	0.0125	
TRIPLE	18	1.34	0.0254	0.006	
LMCA	35	1.25	0.0672	0.0114	P<0.001
NON-LMCA	65	1.05	0.1515	0.0188	

TABLE 3: MULTIPLE LINEAR REGRESSION ANALYSIS SHOWING CORRELATION OF VARIOUS ATTRIBUTES IN DETERMINING THE SEVERITY OF CORONARY ARTERY DISEASE

VARIABLE	COEFFICIENT	STANDARD ERROR	P-VALUE
1.MALE SEX	0.05016	0.1372	0.7154
2.MEAN AGE	-0.005173	0.003319	0.1225
3.OBESITY	-0.02321	0.1453	0.8734
4.SMOKING	0.1037	0.1323	0.4351
5.FAMILY HISTORY	-0.1499	0.1328	0.2619
6.DYSLIPIDEMIA	0.2007	0.1328	0.1342

7.HYPERTENSION	0.1576	0.1328	0.2384
8. MEAN CIMT	1.6369	0.4083	0.0001

FIGURE 1. SCATTER PLOT WITH REGRESSION LINE BETWEEN CIMT AND CORONARY ARTERIES INVOLVED



Abbreviations:

CAD- coronary artery disease

CIMT- carotid intima media thickness

PTCA- percutaneous transluminal coronary angioplasty

ROC- receiver operating characteristic

LMCA- left main coronary artery

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